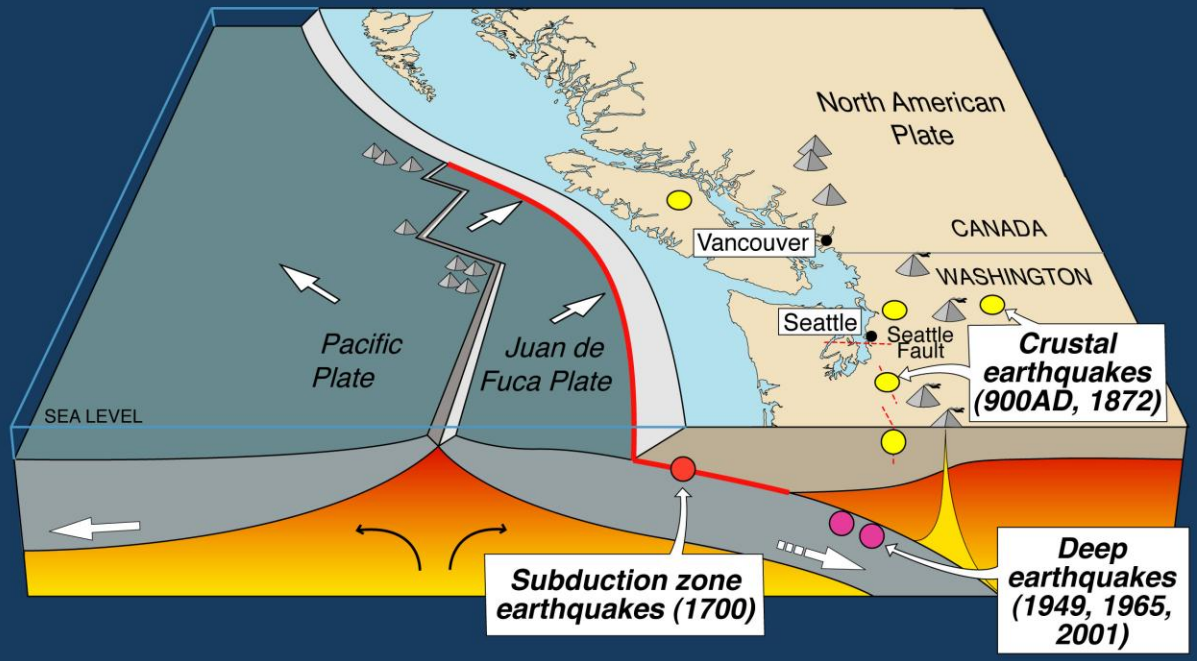
USGS Earthquake Studies: Seattle comes to Richland

Craig S. Weaver
Seattle Field Office
October 25, 2011

The Big Picture

Cascadia earthquake sources

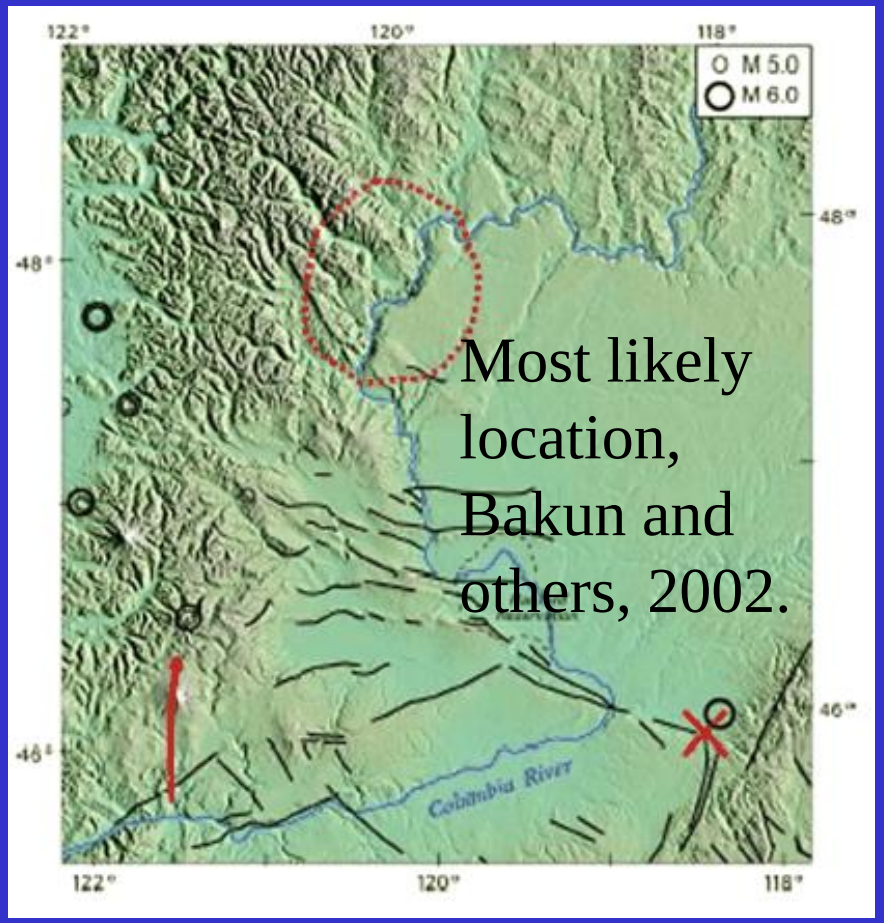


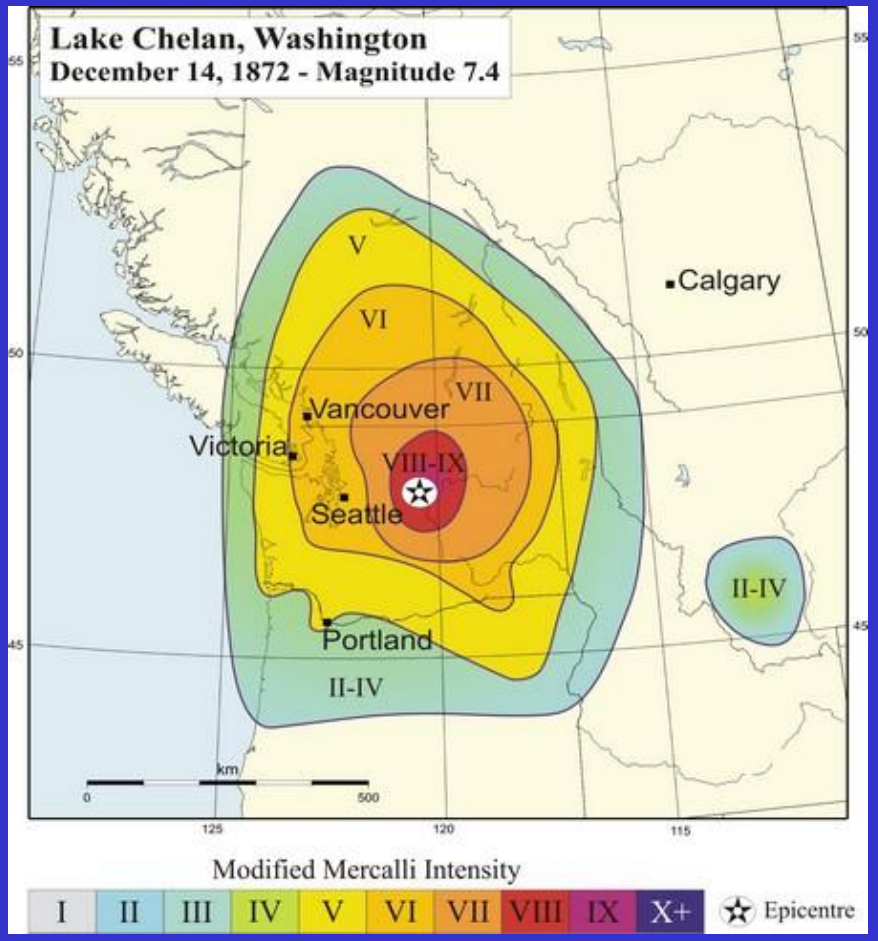
Source	Affected area	Max.Size	Recurrence
Subduction Zone	W. WA, OR, CA	M 9	500-600 yr
Deep JdF plate	W. WA, OR	M 7	30-50 yr
Crustal faults	WA, OR, CA	M 7?	?

Why Eastern Washington?

- Some very interesting, big, historical earthquakes—1872 and 1936
- Recent scientific studies suggest that what happens in Puget Sound doesn't stay/stop there—its linked to eastern Washington
- USGS earthquake hazard assessments have been hampered by lack of data
- Cool stuff happens—Wooded Island Swarm

1872 Earthquake location remains unknown



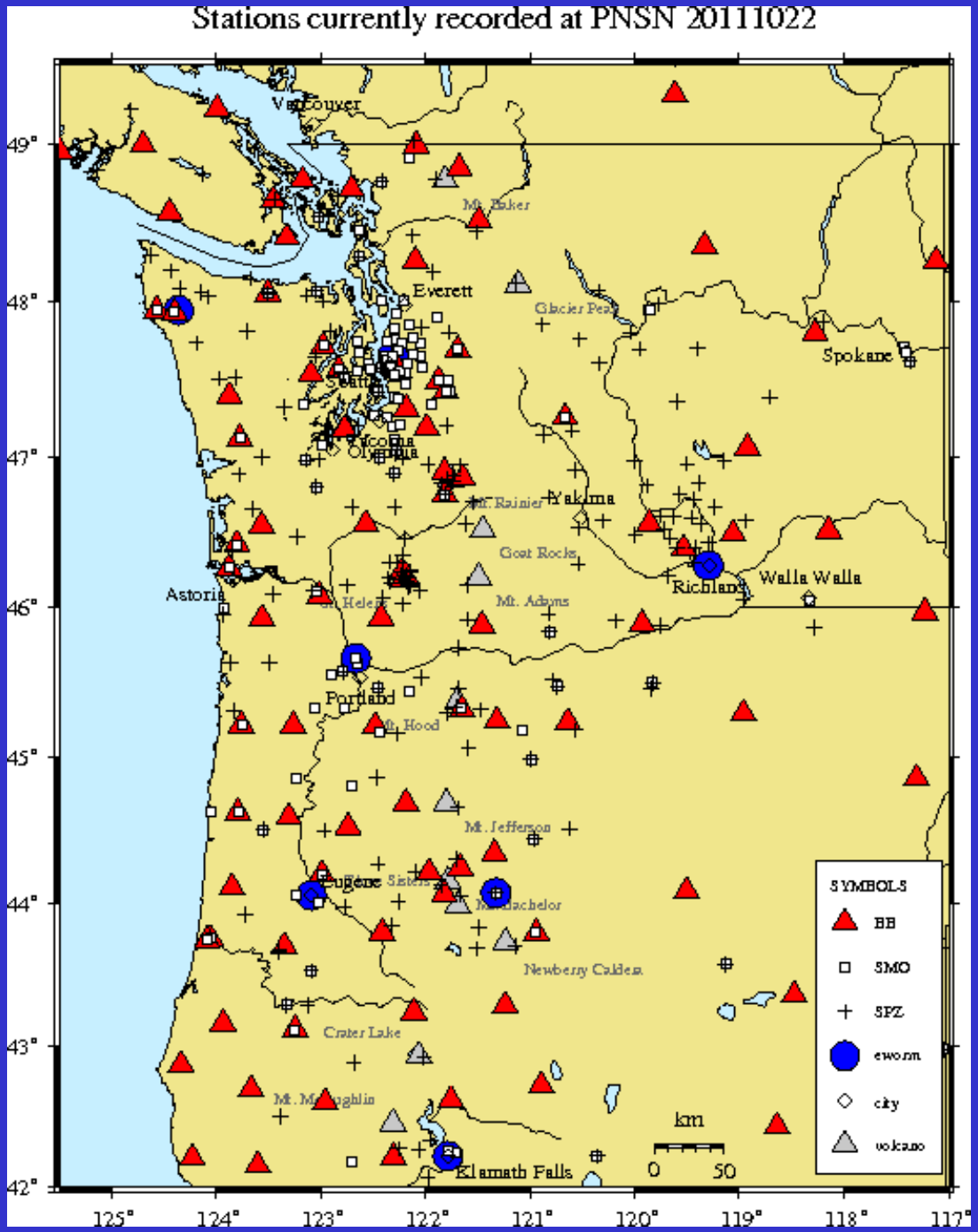


And then there was the stack of cash!

- 2007 Congress added funding for a “Multi-Hazards Demonstration Project” in Southern California to USGS budget
- 2008 Congress added funding for Multi-Hazards studies in Washington and Central US to the USGS Earthquake Program budget
- 2010 Congress added funding for aeromagnetic and lidar studies in eastern WA to the Earthquake Program budget

What Does the USGS Earthquake Program Do for the Tri-Cities?

- **Monitor earthquakes and report locations, magnitudes, and other information in near-real time**
  - **Locally in cooperation with the University of Washington**
  - **Nationally through the National Earthquake Information Center in Golden, CO**
  - **Internationally with the Global Seismic Network through Golden, CO**



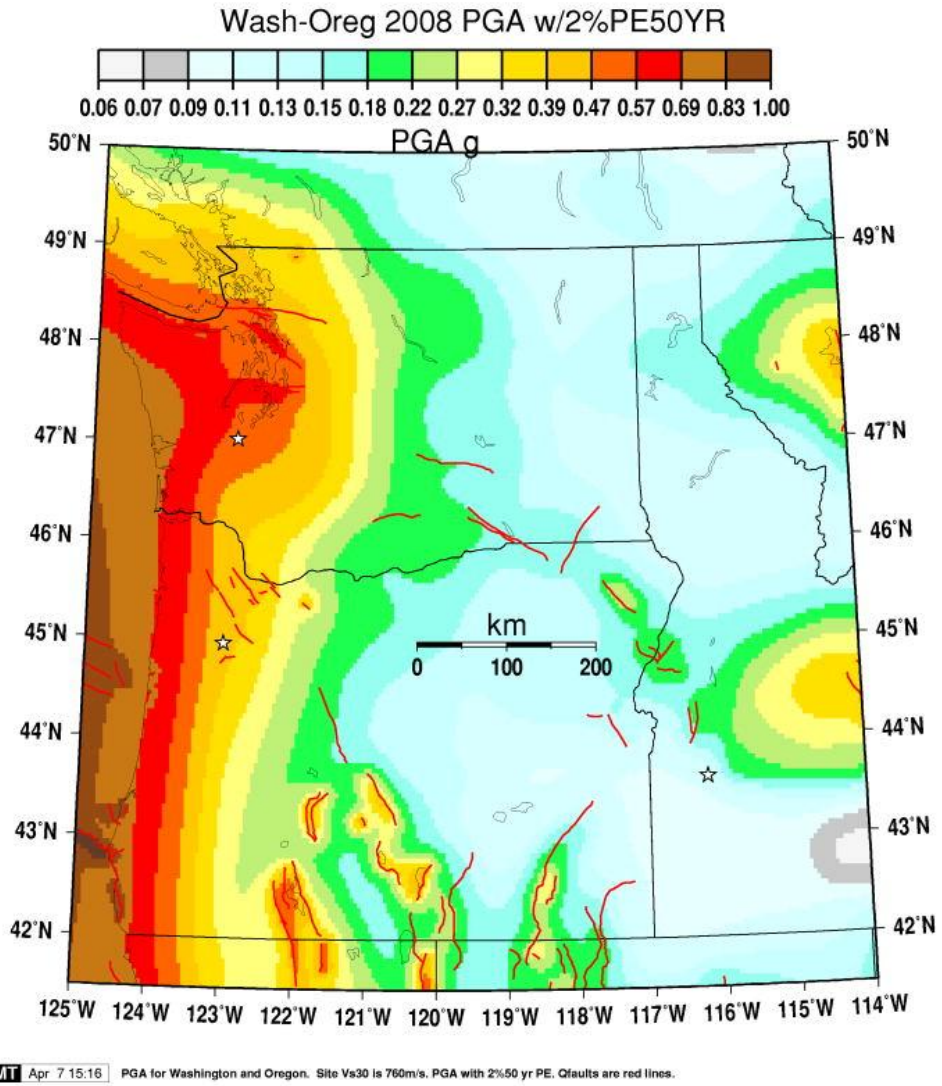
PNSN Capabilities

Regional network capable of locating felt events in about 85% of WA, 75% of OR.

With National Backbone stations, locate most events greater than magnitude 3.5 in WA and OR—missing some felt events.

What Does the USGS Earthquake Program Do For the Tri-Cities?

- **Develop the National Seismic Hazard Maps using all available science of earthquake faults, magnitudes, rates, and strength of shaking**
  - **NSH Maps are used to set the seismic parts of building codes, residential codes, highway structures and many lifeline**
  - **Revised every 4-5 years to incorporate new knowledge such as that gained on the Umtanum Ridge fault**
  - **USGS fault studies go directly into these maps**

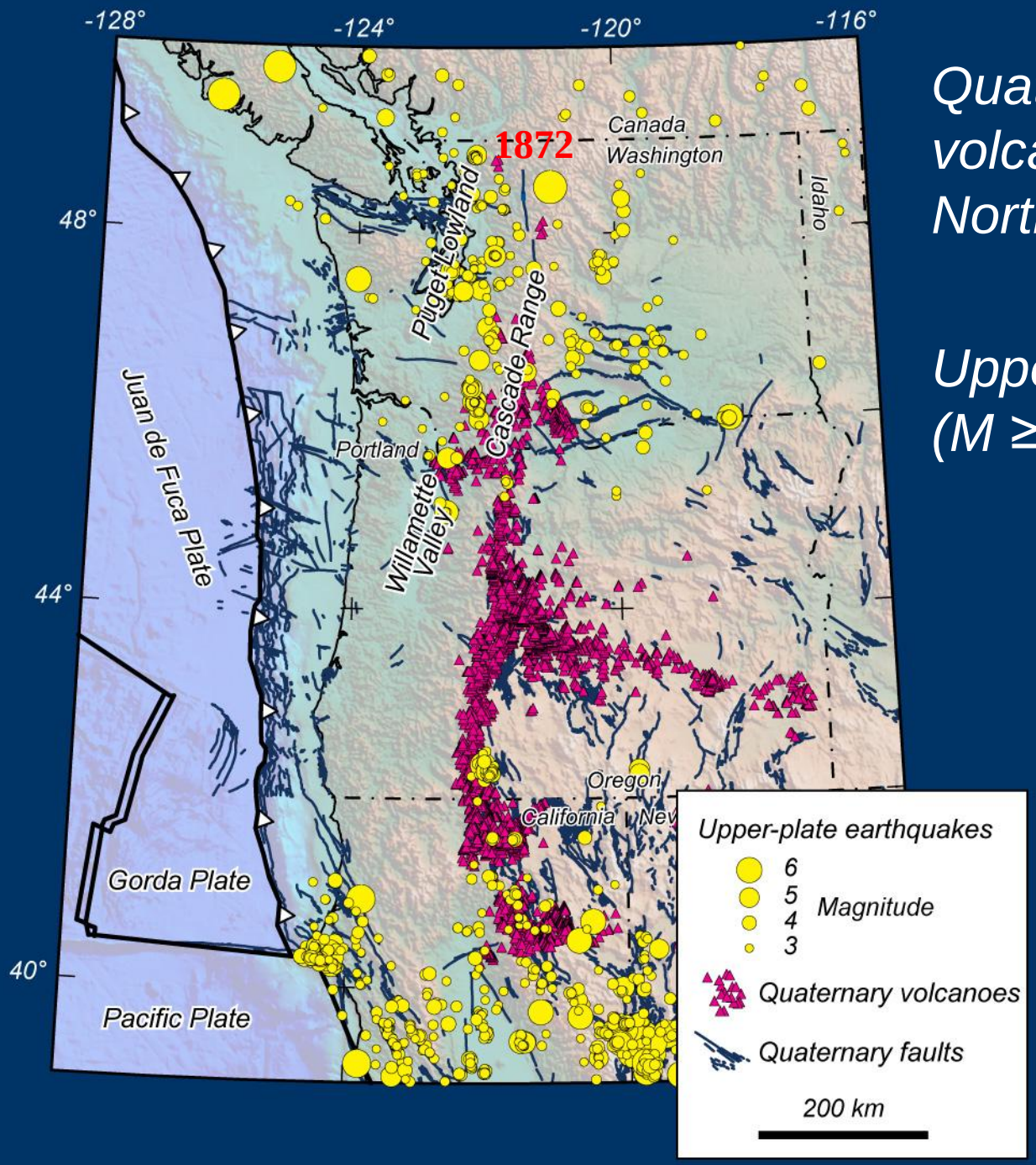


2008 National Seismic Hazard Map, 2% in 50 years, PGA

In eastern Washington there is very little data, thus hazard estimates come with large uncertainties

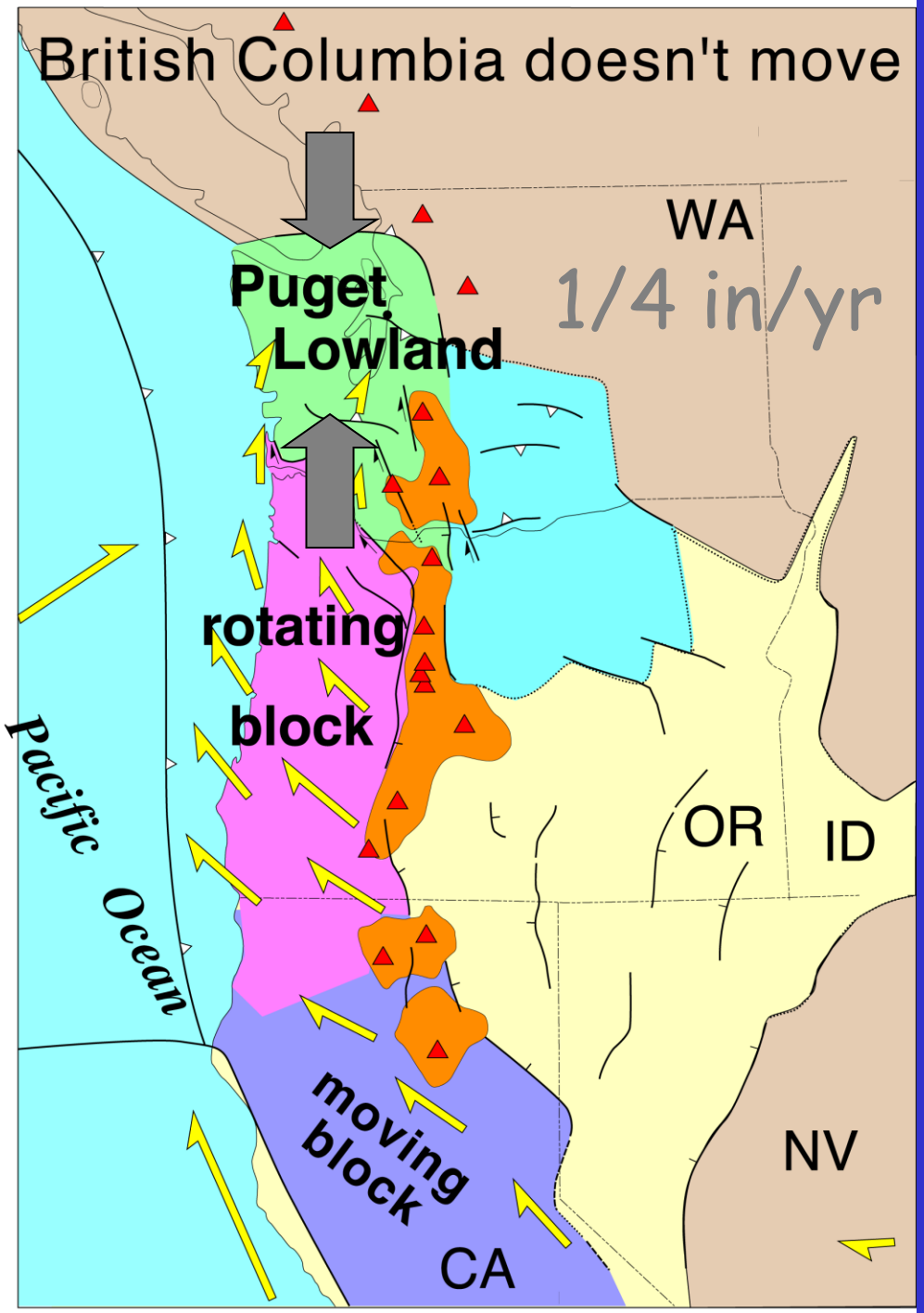
Some west-east similarities

- Current seismicity doesn't outline major fault systems
- Few larger magnitude historical earthquakes to feed into hazard assessments
- Entire area under north-south squeezing
- Series of short faults, not clearly connected into through-going system



Quaternary faults and volcanoes of the Pacific Northwest

Upper-plate earthquakes ($M \geq 3$)



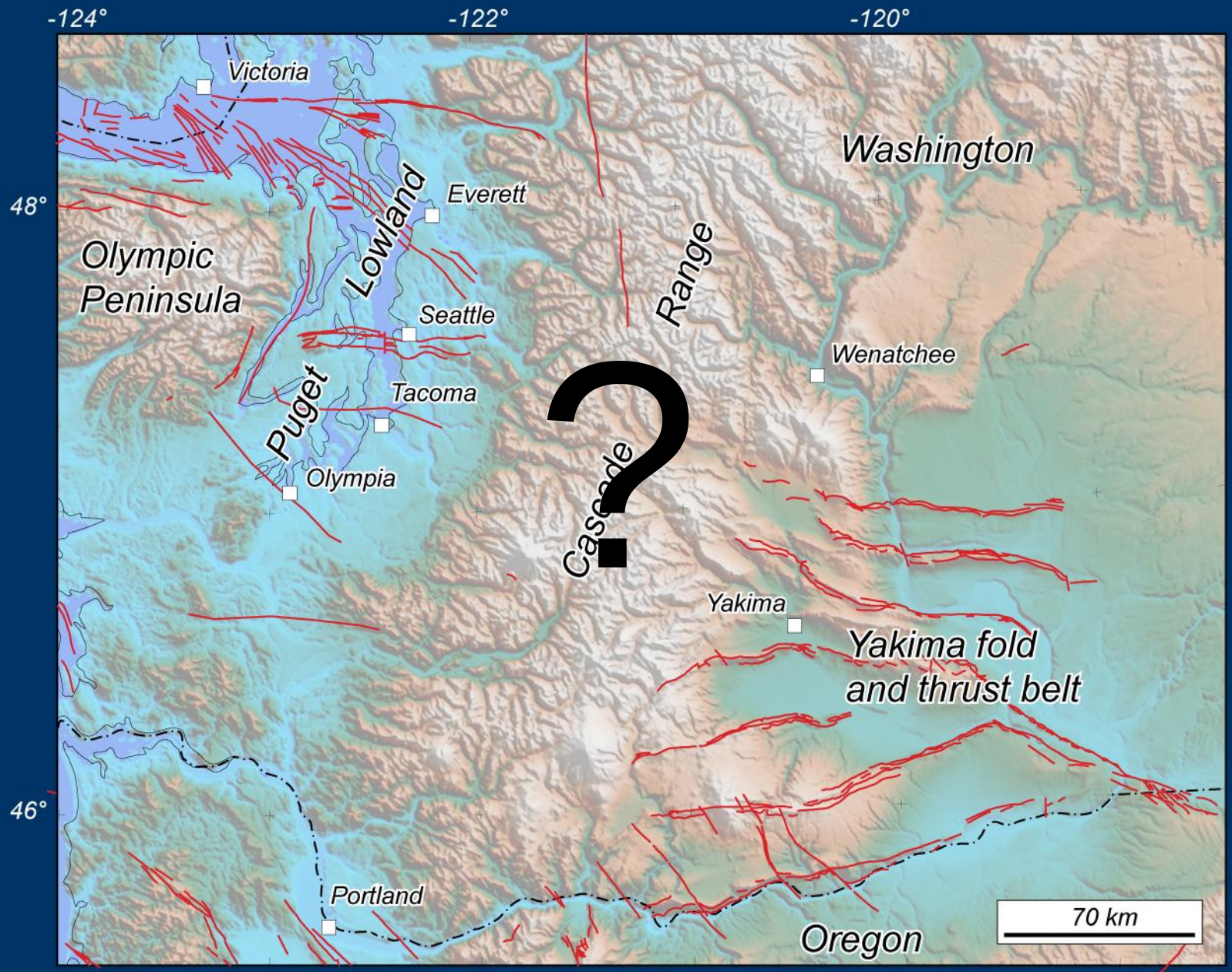
Use Tectonics and Geology

Most of Washington is being squeezed from south to north at a rate of about 1/4 inch/year, less in the east.

How does the earth's crust respond to squeezing?

By folding and faulting!!

Quaternary Faults of Central Washington



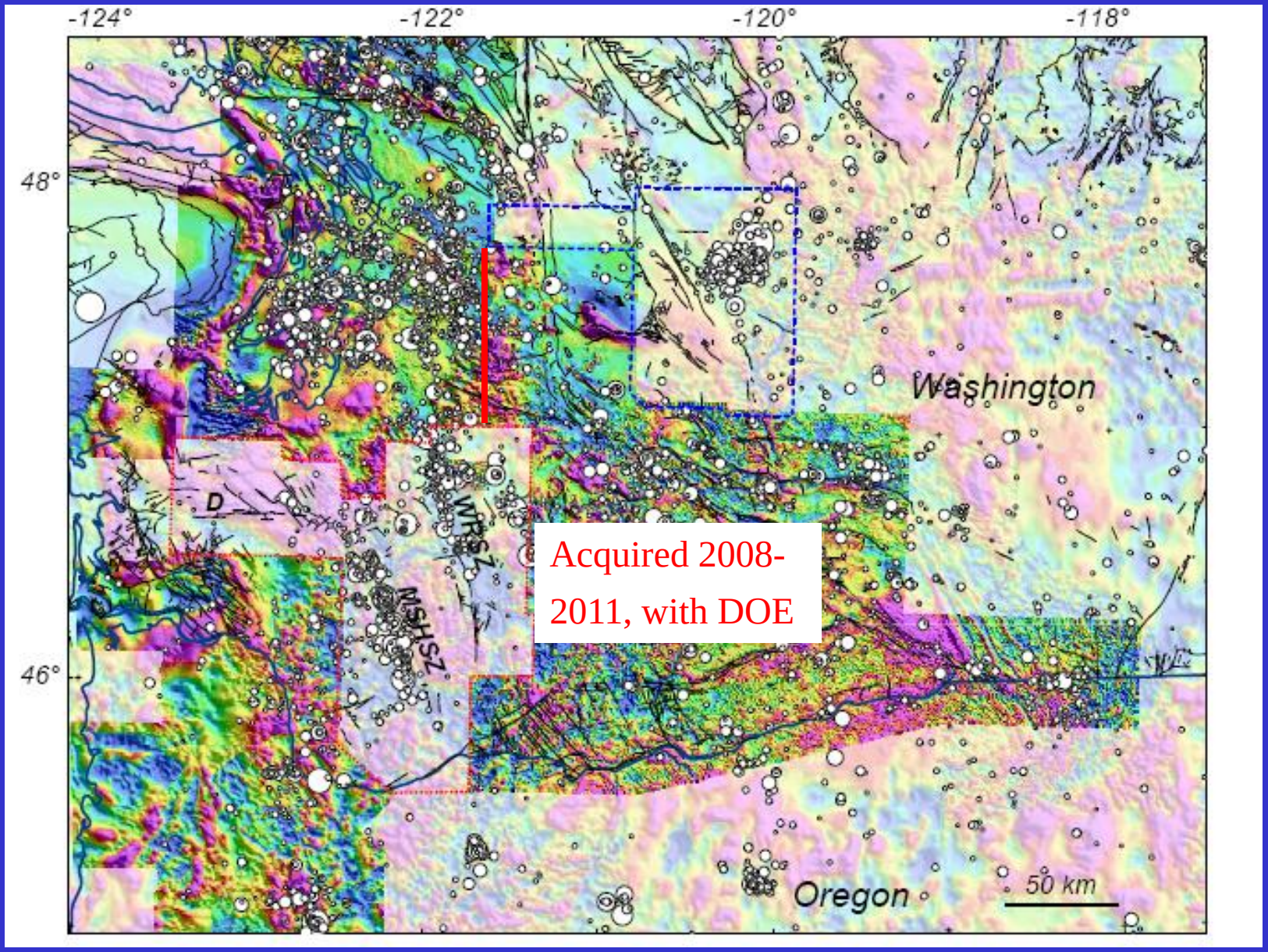
And some important differences

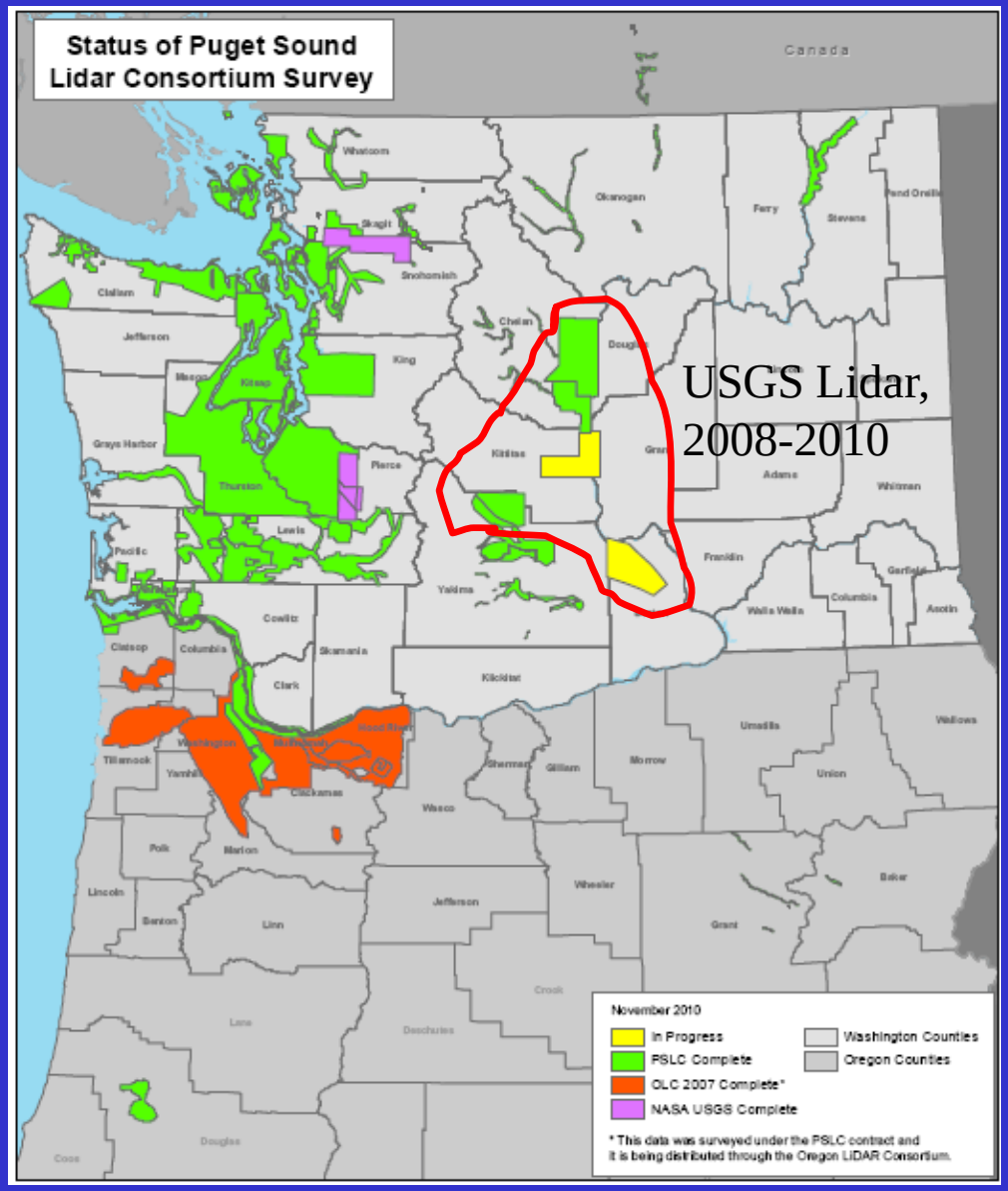
- Eastern Washington does not have deep earthquakes like Nisqually
- Long way from the Cascadia subduction interface (but large structures may have issues)
- Deformation rates somewhat less that in Puget Sound
- Many fault locations are known, but typically not investigated for evidence of recent deformation

Can we find places to determine the fault history—where do earthquakes occur, how big, how often, and why?

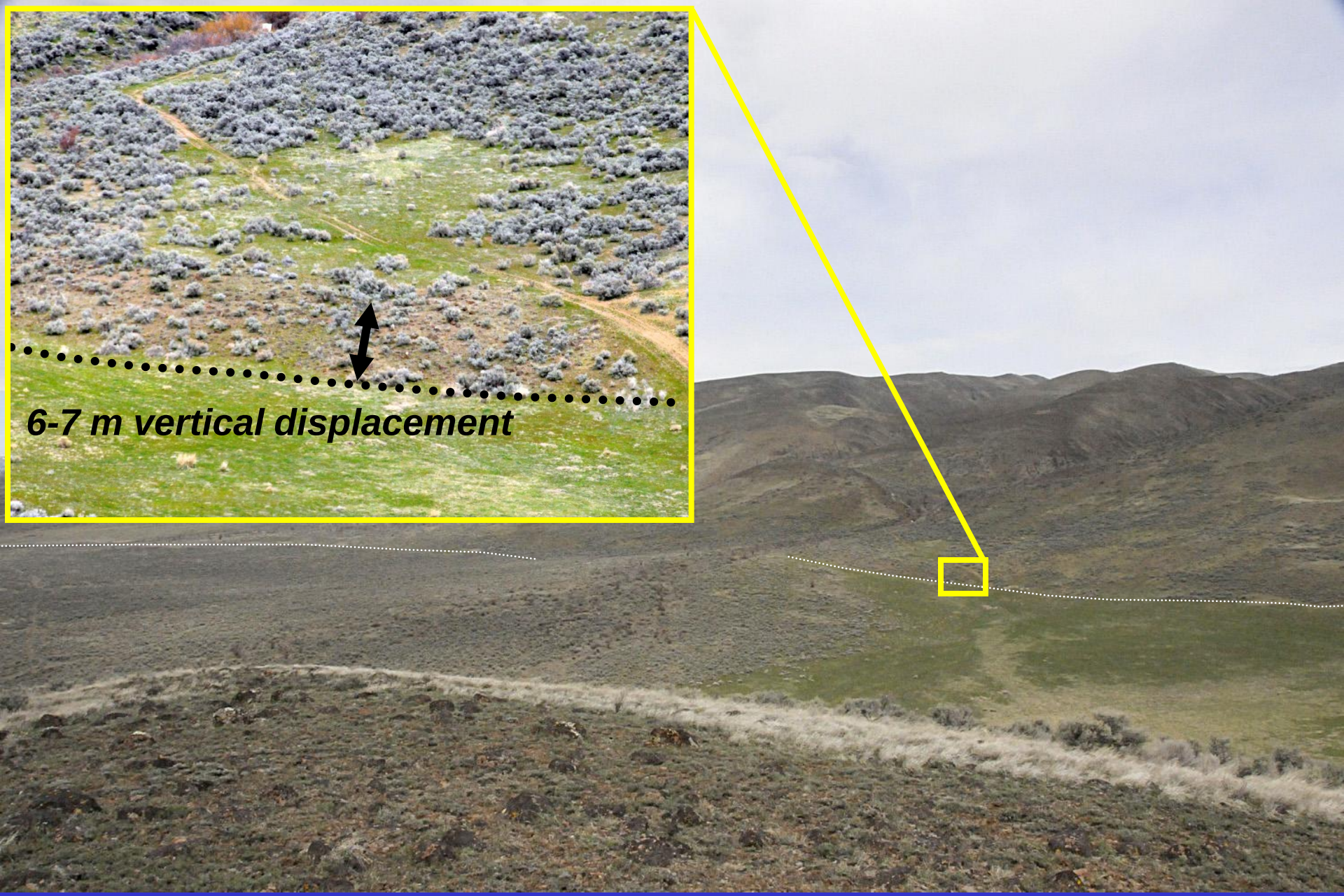
- Rely on fundamental data sets—aeromagnetic surveys, lidar, gravity, seismic surveys, geologic mapping
- Where might we dig?

Status of Aeromagnetic Acquisition





USGS Earthquake Program seeks partners to help expand lidar surveys in eastern Washington. No reasonable offer refused. Douglas County PUD and City of East Wenatchee contributed to USGS Wenatchee survey.



View to north; Umtanum Ridge in background.
Photo by Brian Sherrod

Aeromag+lidar+backhoe

Aeromag+lidar+backhoe+geologist

Aeromag+lidar+backhoe+geologist=trench

What do we do with new information?

- Work to ensure our new work is rapidly understood and used by communities
- No surprises—what we know, you know
- No barriers, everyone is welcome and encouraged to talk with us, pester with questions, push us to better explain
- Vetted discoveries are become input to the next update of the National Seismic Hazard maps
- Becomes basis for answering the “why” question.

Contact Information:

Craig S. Weaver
Pacific Northwest Coordinator
USGS Earthquake Program
@Department of Earth and Space Sciences
University of Washington, Box 351310
Seattle, WA 98195-1310
206-459-6457
craig@ess.washington.edu